The Role of Metacognitive Strategies in Enhancing Learning Outcomes and Educational Efficiency: A Systematic Review of Quantitative, Qualitative and Mixed-Method Studies

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Abstract
Metacognition plays an important role in education, enhancing learning outcomes and promotes educational efficiency across disciplines and educational levels. In this systematic review, we synthesized evidence from 15 studies, adhering strictly to PRISMA guidelines, to explore the impact of metacognitive strategies on academic performance, efficiency, and the contextual factors influencing their effectiveness. Thematic synthesis identified four major topics: (1) impact of metacognition on learning outcomes, (2) the influence of metacognition on educational efficiency, (3) key moderators and mediators of metacognition's effect, and (4) methods of assessing metacognition. The findings showed that metacognitive strategies greatly improve educational performance, self-regulated learning and critical thinking skills. In STEM, these strategies increased the problem-solution accuracy and self-efficacy, while in humanities; they supported reflective practices such as critical reading and writing. Educational efficiency was improved through better time management, low instructional time and greater learner autonomy. Moderators and mediating variables such as age, gender, cultural criteria, teacher support and motivation shaped the effectiveness of metacognitive interventions. Common assessment methods included self-report tool and classroom observation and digital tools, although limited use of real-time techniques such as think aloud protocols highlights an occasion for future research. This review emphasizes the transformative ability of metacognitive strategies, identifying gaps in methodological diversity and geographical representation. Addressing these limitations will lead to better integration of metacognition in global educational practices.
Keywords: Education, Metacognition, Learning Outcomes, Efficiency

Introduction
In contemporary education, metacognition has emerged as a crucial basis for enhancing the outcomes of learning and promote educational efficiency (Famarin, 2024; Summiya &

Hussain, 2024; Swanson et al., 2024). Broadly defined as the awareness and regulation of one's own cognitive processes, metacognition consists of three major components: metacognitive knowledge, metacognitive regulation, and metacognitive experiences (Flavell, 1979; Ozturk, 2024; Setyaningsih & Sumarni, 2023). These components collectively enable learners to plan their approach to tasks, monitor their progress and evaluate the outcomes of effectively learning.

The significance of this study lies in the increasing belief that traditional teaching methods alone may not sufficiently equip students with the necessary problem-solving skills, adaptability and autonomy necessary for lifelong learning. Metacognitive strategies such as self-regulation and reflective thinking strengthen students to take control of their learning, bridging the gap between theoretical knowledge and practical applications (Halmo et al., 2024; Sadykova et al., 2024).). For example, studies have reported a substantial average effect size of 0.808 in learning outcomes when metacognitive strategies are systematically implemented, highlighting their transformative potentials in education. (Antonio & Prudente, 2021). Despite these promising findings, discrepancies in their application across disciplines, age groups, and learning environment reveal gaps in understanding and practical integration (Ilma et al., 2022).

It is essential to address these challenges, as research has consistently demonstrated that metacognitive strategies increase students' outcomes, academic autonomy and long-term success (Fernandez & Guilbert, 2024; Martelletti et al., 2023). Comparative studies show that metacognitive interventions improves traditional learning methods, especially in fostering students engagement and achievement (Marantika, 2021). Individualized interventions tailored to specific learner needs have been particularly effective, leading to high motivation and knowledge retention. However, further investigation is needed to determine how these strategies can be adapted across educational settings and cognitive profiles.

The necessity of this study is further underscored by the need for institutional and educational alignment. While students with greater metacognitive awareness demonstrate strong problem-solving skills and are independence in their academics, the effectiveness of metacognitive strategies depends on adequate institutional support and well-induced teacher training programs (Sadykova et al., 2024; Sukarelawan et al., 2024). Cross-cultural studies suggest that metacognitive strategies have broad applicability, yet challenges such as limited institutional resources and varying cultural attitudes towards self-regulation hinder widespread adoption (Karagianni, 2024). To address these challenges, not only requires institutional investment, but also there are teacher training programs that emphasize the integration of metacognitive strategies in classroom instructions.(Ajayi, 2024; Sanjaya et al., 2024).

The theoretical underpinning of this study are grounded in the Flavell's Metacognition Theory, which highlights the importance of metacognitive regulations in learning, and the theory of learning of Vygotsky, which emphasizes the role of social interaction in cognitive development (Ilma et al., 2022; Kharroubi & ElMediouni, 2024). These frameworks provide a foundation to develop actionable models that integrate metacognitive strategies into instructional design. Longitudinal studies have shown that such models consistently contribute to educational efficiency, strengthening the need to translate the theoretical insight into scalable, practical

applications (Martelletti et al., 2023). However, many of these models remain underutilized, emphasizing the necessity for more accessible and adaptable framework (Antonio & Prudente, 2021)

The aim of this systematic review is to bridge the gap between theory and practice by synthesizing evidence on the role of metacognitive strategies in enhancing learning outcomes and educational efficiency. By identifying gaps in existing literature and evaluating the effectiveness of various metacognitive approaches, this study will provide actionable insights to educators, policy makers and curriculum developers. Beyond immediate academic benefits, metacognitive strategies hold the potentials to promote lifelong learning skills, preparing students to navigate the rapidly complex educational and professional landscape.

Methodology
Research Design
This study employs a systematic review approach to synthesize existing literature on the impact of metacognition on learning outcomes and educational efficiency. The review follows Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, ensuring methodological rigor and transparency.

Eligibility Criteria
To ensure the relevance and quality of studies included in this systematic review, predetermined inclusion and exclusion criteria were installed. These criteria guided the selection process to increase the reliability and validity of the conclusions. Publications were required to meet six distinct criteria before being considered eligible for inclusion:
1) Appear in peer-reviewed journal;
2) should published within the last ten years (2016-2025);
3) should clearly address metacognition, learning results and educational efficiency ;
4) empirical research that employs only quantitative, qualitative or mixed-method approaches;
5) directly aligned with the objectives of the study; and
6) published in English

The first criterion has ensured the inclusion of high quality, reliable research, which has undergone rigorous peer review, the second which led to the third criterion ensures that only publications published from 2016 to 2025 were considered with the inclusion of the core variables related to this study, given that the field of metacognition, learning outcome, and educational efficiency is relatively new and is recently discovered more. The fourth criterion ensures to include studies that provide solely primary evidence-based insights, allowing for the comprehensive and data-driven analysis of the relationship between the variables of this study. The fifth criterion ensures that only studies relevant to the core research focus are included, which prevents the inclusion of tangent or unrelated literature that can dilute the findings of the review. The final criterion ensures consistency in data interpretation and avoids potential biases or inaccuracies that can arise from translation limitations (See Table I for Inclusion and Exclusion Criteria).

Table I
Inclusion and Exclusion Criteria

S/N	Inclusion criteria	Exclusion criteria
1.	Only studies published in peer- reviewed journals	Non peer-reviewed sources, book chapters, conference paper, and meeting reports
2.	Studies published within the last ten years	Studies retracted or un-accessible
3.	Studies focused on metacognition, learning outcome and efficiency in education	Studies not directly related to metacognition, learning outcomes, or educational efficiency
4.	Empirical studies employing quantitative, qualitative, or mixed-method approaches.	Studies lacking empirical evidence
5.	Studies directly aligned with the study objectives	Redundant studies/ studies that are not aligned with the research objectives
6.	Studies published in English	Studies published in languages other than English

Article Searching Strategy and Selection Process
This study conducted a systematic search for articles examining the influence of metacognition on learning outcomes and educational efficiency. Relevant data were collected from published sources using Scopus, ProQuest, and Google Scholar, Emerald and Eric databases. Previous reviews were used to help define our search strategy; Keywords and Boolean operators were considered separate and in aggregation when searching for five databases. This study employed the following terms and operators: ("Metacognition" OR "metacognitive awareness") AND ("Learning Outcomes" OR "Academic Performance") AND ("Educational Efficiency" OR "Teaching Effectiveness"). This method facilitated the identification and organization of literature related to how metacognition affect learning outcome and efficiency in education. Initially, we uploaded search results to Zotero (version 6.0.26.0). After removing duplicates, we independently extracted data from each article based on the eligibility criteria (See Figure I)
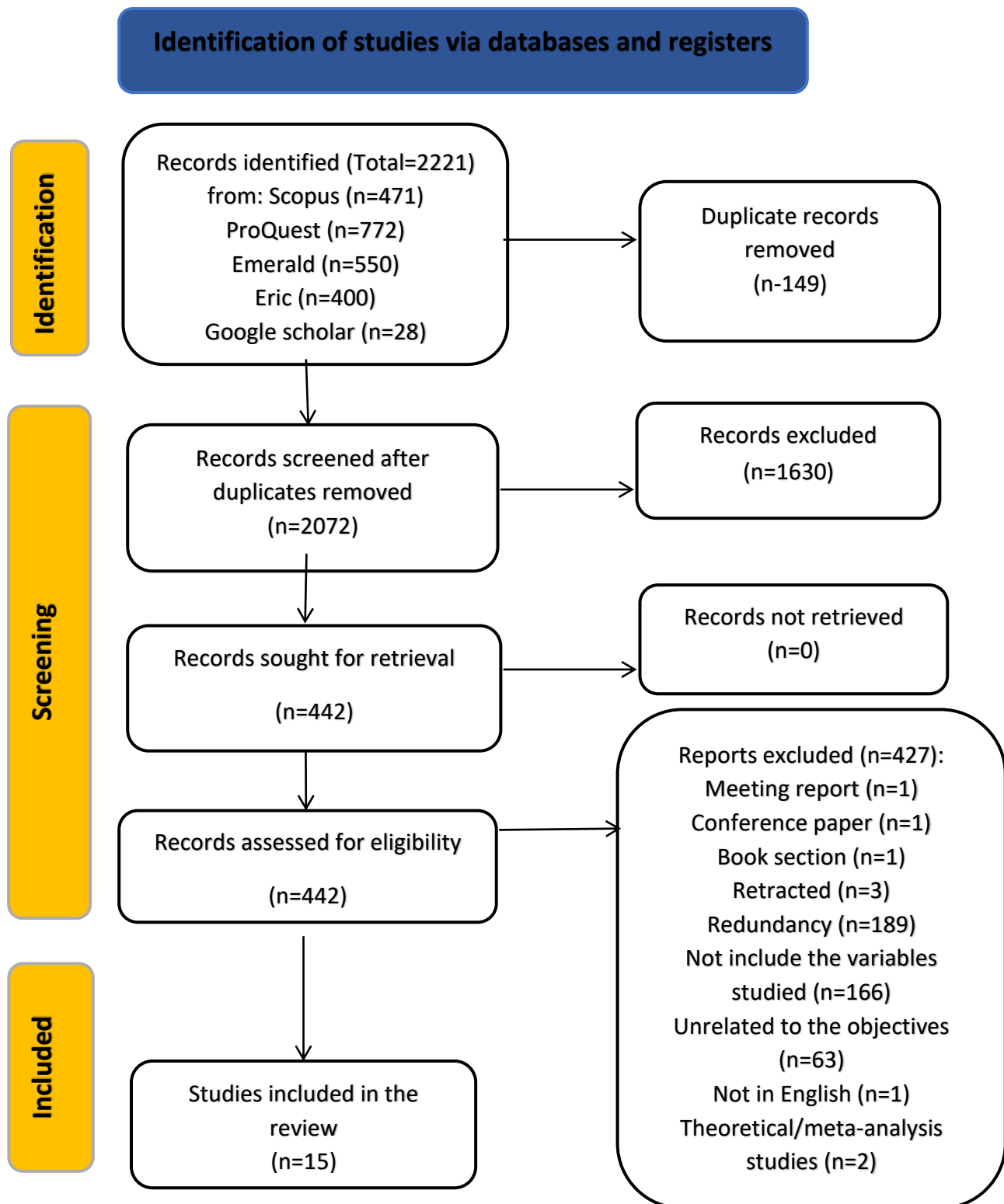
Figure I: PRISMA Summary of the selection process (Turkem, 2024)

Data Extraction and Synthesis

A standardized data extraction process was applied to ensure accuracy and stability. A structured extraction form was developed to catch major information from selected studies. The data extracted included study characteristics (author, year, country of publication),

research design (quantitative, qualitative, or mixed methods) and methodology, sample size, study area, and outcome measures related to metacognition, learning outcomes, and educational efficiency. A thematic synthesis approach was used for data, allowing for the identification of recurring patterns and key themes. Also, for quantitative studies, statistical findings, effect sizes, and significance levels were documented where necessary. When feasible, meta-analysis was conducted to provide a statistical summary of the results, ensuring comparability across studies. To ensure reliability, two independent reviewers extracted data, with discrepancies resolved through discussion or consultation with a third reviewer. The data extracted to facilitate comparison was arranged in tables. Trends, gaps, and methodological variations across studies were analyzed to provide a comprehensive synthesis of the findings.

Results

Overview of Included Studies

The systematic search identified 2,221 records in the five academic databases: Scopus, ProQuest, Emerald, Eric and Google Scholars. After removing the 149 duplicate records, 2,072 remained for unique study screening. Based on a title and abstract review, 1,630 records were excluded to not meet the inclusion criteria. The remaining 442 studies evaluated the complete text for eligibility. After a detailed evaluation, 427 studies were excluded due to excess, lack of relevance for study variables, unrelated to the scope of study, or a meeting report, conference paper, book section, or back article, Theoretical/meta-analysis papers. Additionally, studies not written in English were excluded. As a result, 15 studies met all inclusive criteria and were included in the final review. (See Table II for the characteristics of included studies)

Table II

Study Characteristics of Included Studies

S/N	Author(s) & Year	Study Tittle	Sample size	Study design	Methodology/Metacognition strategy	Educational level
1.	Albazi & Shukri (2016)	Evaluating the Effect of Metacognitive Strategy Training on Reading Comprehension of Female Students at KAU	Not specified	Quantitative (Quasi-Experimental (Pretest-Posttest Design)	Metacognitive reading strategy training (planning, monitoring, evaluation)	Higher Education (University-Saudi Arabia)
2.	López-Vargas, Ibáñez-Ibáñez, & Racines-Prada (2017)	Students' Metacognition and Cognitive Style and Their Effect on Cognitive Load and	54 students	Quantitative (Quasi-Experimental Study)	Used a hypermedia learning environment with and without metacognitive scaffolding; analyzed cognitive load using a cognitive load questionnaire; measured	Secondary Education (Grade 11 Columbia)

		Learning Achievement			learning achievement with multiple-choice tests.	
3.	Öztürk & Şenaydın (2019)	Dichotomy of EFL reading: Metacognition vs. proficiency	63 students	Quantitative (Variance Analysis Study)	Metacognitive Awareness Inventory (MAI) and reading scores	Higher Education (EFL Learner-Turkey)
4.	Zepeda et al., 2019	Identifying Teachers' Supports of Metacognition Through Classroom Talk and Its Relation to Growth in Conceptual Learning	40 classroom videos	Qualitative Observational Study	Classroom discourse analysis to assess teachers' verbal metacognitive supports	Middle School (USA, Math Education)
5.	Abdelrahman (2020)	Metacognitive awareness and Academic Motivation and their impact on academic achievement of Ajman University students	200 students	Quantitative Correlational Study	PLUS-SEM analysis	Higher Education ((University Ajman, UAE)
6.	Chytrý et al. (2020)	Metacognitive Knowledge and Mathematical Intelligence— Two Significant Factors Influencing School Performance	280 pupils	Quantitative Correlational Study	Metacognitive knowledge tested using the MAESTRA5-6+ tool; mathematical intelligence assessed based on six cognitive dimensions.	Lower-secondary school (Grade 7, Ages 12-13, Crech Republic)
7.	Marantika, (2021)	Metacognitive ability and autonomous learning strategy in improving learning outcomes	30 students	Quantitative Study Descriptive	Survey-based study using standardized questionnaires	Higher Education (University Indonesia)
8.	Potgieter & van der Walt (2022)	Metacognitive awareness and the zone of proximal intermediate phase	10 in-service Teachers	Qualitative Study	Data collected through individual interviews, reflective prompts, observations, and reflective journals to assess the impact of	Primary Education (Intermediate phase Mathematics

		mathematics teachers' professional development			professional development interventions.	Teachers, Grade 4-6 South Africa)
9.	Ilma et al. (2022)	Promoting students' metacognitive awareness and cognitive learning outcomes in science education	144 students	Quasi-Experimental (Pretest-Posttest Non-Equivalent Control Group Design)	Project-Based Learning (PBL), Predict-Observe-Explain (POE), and POE-Based Projects (POEP) were used as interventions; data collected via questionnaires and essay tests.	Upper Secondary Education (Grade 10 high school students in Tarakan, Indonesia)
10.	Razzaq & Hamzah, (2023)	Assessing Metacognitive Strategies: The Influence of Evaluation on Writing Performance among Pakistani ESL Learners—A Comprehensive Mixed-Methods Study	500 Students	Mixed-Method (Survey+Interview)	PLS-SEM statistical modeling, qualitative thematic analysis	Higher Education (BS English Students-Pakistan)
11.	Mohamed & Shaaban (2023)	Investigating College Students' Metacognitive awareness in enhancing ESP writing proficiency	90 students	Quantitative Study	Survey based study (MAWQ)	Higher Education (Applied College Student-Saudi Arabia)
12.	Arianto & Hanif (2024)	Evaluating metacognitive strategies and self-regulated learning to predict primary school students' self-efficacy and problem-solving skills in science learning	100 students	Quantitative (Factorial Design, 2x2 Experimental Setup)	Tests and questionnaires on metacognitive strategies and self-regulated learning	Primary School (Indonesia)
13.	Mustopa et al. (2024)	Investigating Senior High School Students' Metacognition in	280 Students, 8 Teachers	Mixed-Method (Descriptive and Correlational Analysis)	Observations, Interviews, questionnaires and reading Skills tests	Senior High School (Indonesia)

		Indonesian Learning Reading Comprehension: Does it Have a Positive Impact?				
14.	Hays et al. (2024)	Metacognitive Management of Attention in Online Learning	1,409,480 university students	Quantitative study Observational Study	Time-based analysis of interruptions in online learning interactions using outlier detection and statistical modeling.	Higher Education (University Students in online learning environment, global sample)
15.	An, Yea and Liu (2024)	The influence of metacognition on learning engagement the mediating effect of learning strategy and learning behavior	2,989 participants (University students - Five Universities in Henan, Jiangsu, and Shanxi, China)	Quantitative Study	Handy sampling method	Higher Education (College Students)

Distribution of Studies by Educational Level

The below chart presents the distribution of studies included in the systematic review based on educational levels: primary education, secondary education and higher education. Most of the study involved (8 out of 15, or 53.3%) focus on higher education, indicating a major emphasis on exploring metacognition impact within the post-secondary learning environment. Secondary education account for five included studies (33.3%), reflecting moderate representation in the review. In contrast, primary education includes only two included studies (13.3%), which highlight a notable gap in research that addressed metacognitive strategies at foundational academic levels. This distribution suggests an opportunity for future systematic reviews to include more primary and secondary education studies to ensure a wide understanding of the influence of metacognition across all educational stages.
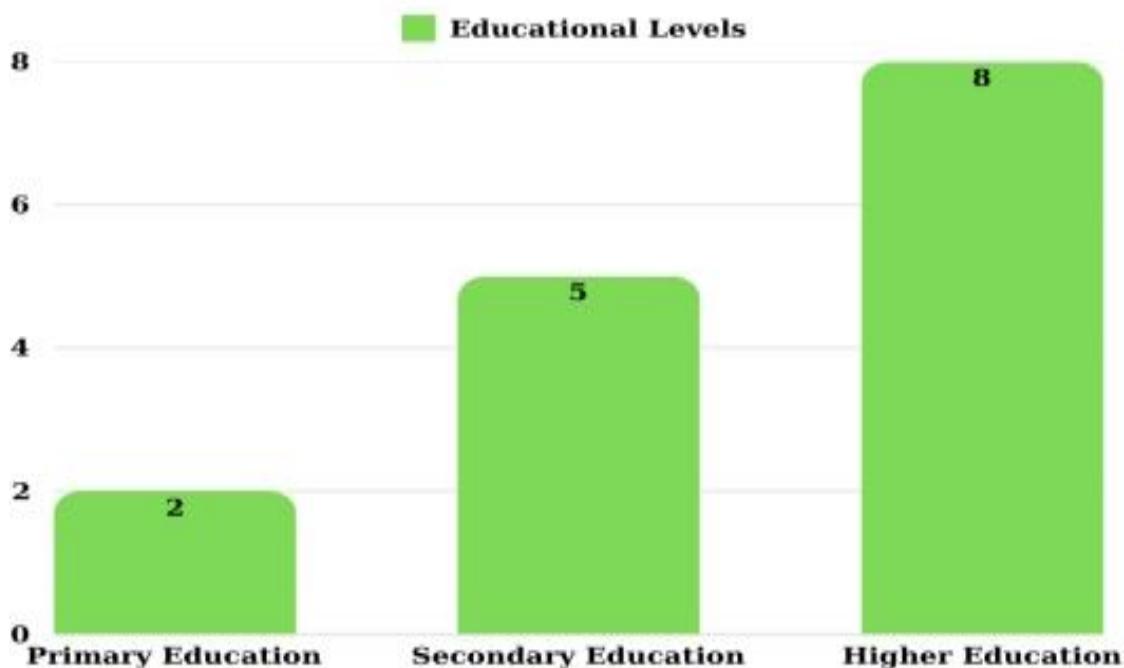
Figure II: Distribution of Included Studies by Educational Level

Distribution of Included Studies by Methodology
This chart depicts the distribution of studies included in systematic review based on their methodological approaches, classified as qualitative, quantitative and mixed methods. Most of the studies included (11 out of 15, or 73.3%) employ a quantitative   methodology, which results in predominant reliance in numerical data and a major statistical analysis to examine the effects of metacognitive strategies on learning outcomes and educational efficiency. In contrast, qualitative and mixed-method studies are equally represented; each with only two studies (13.3%) contributing to the review. This distribution reveals a notable imbalance in the methodology, with qualitative and mixed-methods approaches being significantly underrepresented. Such underrepresentation has highlighted the need for future research to adopt more diverse methodological frameworks to provide overall understanding of metacognition's nuanced and context-specific impacts.
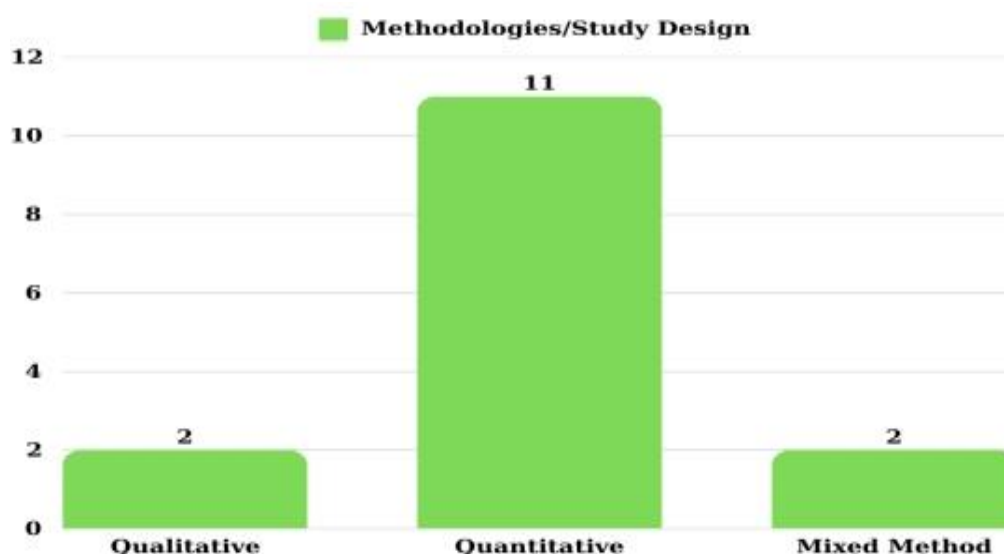

Figure III: Distribution by Educational Level

Distribution of Studies by Research area/Region
This chart shows the distribution of studies included in the systematic review based on their research regions. Most studies (33.3%) were held in Southeast Asia, which reflect substantial interest in the educational practices and contexts of the region. Similarly, another 33.3% of the incorporated studies were done in the Middle East, exposing a comparable level of focusing on metacognitive strategies in the area. Western countries contributed to 26.7% of the studies, which suggests slightly lower representation, compared to the aforementioned regions. In contrast, Africa was responsible for only 6.7% of studies. This distribution underlines geographical inequality in research on metacognition, with limited contributions from Africa, despite its diverse educational systems and potential for contextual insights. Future research efforts should address this imbalance by encouraging studies in underrepresented regions to ensure a more global and equitable understanding of the role of metacognition in education
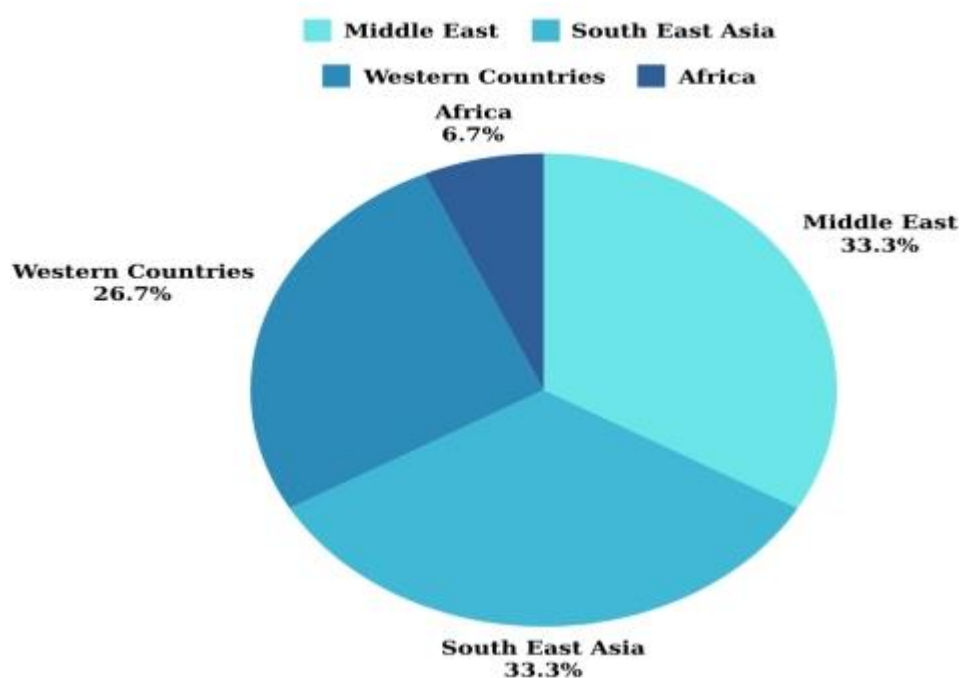

Figure IV: Distribution by Research Area

Thematic Synthesis
From the 20 literature sources included in this systematic review, three descriptive themes were extracted, directly aligned with the objectives of the study. These themes are:
1. The Impact of Metacognition on Learning Outcomes,
2. The Influence of Metacognition on Educational Efficiency,
3. Key Moderators and Mediators of Metacognition's Effect, and
4. Methods of Assessing Metacognition Awareness

A thematic synthesis approach was employed to systematically identify common patterns and relationships within the findings. This approach allowed for the integration of evidence in diverse studies, providing a comprehensive understanding of how metacognitive strategies affect the outcomes of learning, increase efficiency, and are moderated by contextual factors. The themes extracted themes are are supported by strong evidence from studies involved and provide insight into extensive applications of metacogulation in education.

Descriptive Theme 1: Impact of Metacognition on Learning Outcome
Data from 10 (67%) included studies contributes to this theme. These studies highlighted the important role of metacognition in improving the outcomes of learning across diverse educational contexts. Metacognition enhances learning outcomes by enabling students to effectively plan, monitor and regulate their cognitive processes. Research findings demonstrate how metacognitive strategies improve academic performance, promote high-order cognitive skills, and support self-regulated learning. For example, (Abdelrahman, 2020) demonstrated that metacognition helps learners to achieve personal goals successfully by selecting appropriate cognitive tool. The study emphasized that metacognitive awareness is a important contributor to success in learning and an excellent predictor of academic performance. Similarly, (Ozturk & Senaydin, 2019) explored the EFL reading dichotomy, found that metacognitive strategies significantly enhanced reading comprehension and facilitated the development of self-regulations among learners. López-Vargas et al. (2017) observed that students who engaged with metacognitive scaffolding achieved significantly higher academic outcomes compared to those who did not, further reinforcing the metacognition values in fostering the success of learning.

Chytrý et al., (2020) also highlighted the importance of metacognitive interventions in mathematics, demonstrating their effectiveness in enhancing problem-solving skills, particularly among underperforming students. In science education, (Arianto & Hanif, 2024) found that metacognitive strategies increased students' self-efficacy and improved their ability to solve complex problems. This is supported by the discovery (Ilma et al., 2022), who reported equal results in STEM contexts. An et al. (2024)) emphasized that metacognitive awareness supports self-regulated learning by equipping students with equipment to set the goals of learning, monitor their progress and adapt strategies, which result to greater engagement and academic success. In the context of reading comprehension, (Albazi & Shukri, 2016) observed that metacognitive strategies especially planning, monitoring and evaluation play an important role in developing students' reading skills. Mohamed and Shaaban, (2023) similarly underscored the importance of metacognitive strategies in improving writing skills, highlighted their ability to increase plan and execution in educational tasks.
Finally, (Marantika, 2021) demonstrated a significant relationship between metacognitive ability, learner autonomy, and learning outcome in Indonesian language courses, and supported broader links between more metacognition and academic success.

Descriptive Theme 2: Impact of Metacognition on Educational Efficiency
Data from 6 (40%) included studies contributes to this theme. The research findings indicate that metacognitive practices significantly enhance educational efficiency by optimizing to teaching methodology, resource usage and learning outcome. Research carried out by Marantika (2021) demonstrated that metacognitive tools not only reduced instructional time, but also promoted more productive and autonomous learning behavior among students. Similarly, (Antonio & Prudente, 2021) reported that integrating metacognitive prompts into online learning environments improved the students' time management and resource allocation, reducing the completion times while fostering independent learning efficiency.
It was found out that metacognition contributes to educational efficiency at the individual, classroom, and institutional levels. The study of Zepeda et al. (2019) observed that classrooms implementing structured metacognitive interventions gained significant advantage in

conceptual understanding in mathematics. Teacher-led metacognitive practices in these settings were shown to reduce the need for remedial instruction, demonstrating their role in promoting long-term comprehension and systemic benefits. (Razzak & Hamzah, 2023) further emphasized those metacognitive evaluation strategies in ESL writing improved learners' writing proficiency while reducing their reliance on teacher feedback, streamlining the learning process.

Potgieter and van der Walt (2022) highlighted the importance of metacognitive awareness in professional development, enabled teachers to reflect, self-regulate and adapt their teaching methods. Similarly, (Albazi & Shukri, 2016) found that the metacognitive reading strategy empowered the students to independently resolve comprehension difficulties, reducing the demand for additional academic support. In addition, schools adopting the metacognitive teaching frameworks reported extensive institutional benefits, including better retention rates particularly among underperforming student populations. These findings outline the important role of metacognition in achieving efficiency in teaching and learning, highlighting its potential to optimize the use of resources while improving educational outcomes across diverse contexts.

Descriptive Theme 3: Key Moderators and Mediators
Data from 7 (47%) contributed to this theme. It was found out in this studies that the effect of metacognition on learning outcomes and efficiency is affected by several moderators and mediators, including age, gender, cultural context, motivation and teacher support.

Age plays an important role, with young learners often requires explicit guidance to effectively adopt metacognitive strategies, while older learners benefit more from autonomous applications. For example, (Ozturk & Senaydin, 2019) demonstrated that the effectiveness of metacognitive practices varies in age groups and levels of proficiency, which emphasizes the need for tailored instructional approaches. Similarly, (Arianto & Hanif, 2024) observed that structured guidance was essential for primary school students to successfully implement metacognitive techniques, especially in contexts of learning science. Gender differences also influence metacognitive awareness and performance. Mohamed and Shaaban (2023) found that female students displayed high level of metacognitive awareness compared to their male counterparts, excelling in both knowledge and regulation of cognition.

Furthermore, cultural context also shapes the application of metacognitive strategies. Mustopa et al. (2024) in his study, noted that the collaborative approaches for metacognition were more effective in collectivist cultures, where the group-oriented learning environment provided convenience to adopt reflective practices In contrast, (Razzak & Hamzah, 2023) independent reflection was more beneficial in individualist cultures, aligning with the preference of learners for self-regulated learning. In addition, motivation plays a significant mediating role in metacognition strategies effectiveness. Intrinsically motivated learners are more likely to engage deeply with metacognitive practices, which improve learning outcomes. (An et al., 2024a) reported significant increase in engagement and performance among the motivated students employing metacognitive strategies.

Finally, teacher support mediates the successful implementation of metacognitive interventions. Zepeda et al. (2019) demonstrated that teacher-led discussions incorporating metacognitive questioning significantly enhanced students' reflective practices, promoting better learning outcomes. Teachers' ability to scaffold and model metacognitive strategies were identified as an important factor to help students internalize and implement these techniques effectively. These findings underscore the complexity of applying metacognitive strategies and highlight the importance of relevant approaches to maximize their impact in diverse educational settings.

Descriptive Theme 4: Methods of Assessing Metacognition
In the included studies, various methods were employed to assess metacognition, which reflects diversity in research approaches. Self-report inventories, especially the Metacognitive Awareness Inventory (MAI), were widely used to measure knowledge of cognition and regulation of cognition. For example, (Abdelrahman, 2020) used MAI to examine the metacognitive abilities of the participants, while (Ozturk & Senaydin, 2019) applied it to evaluate students' strategic reading skills in a foreign language Which provides reliable quantitative data on metacognitive awareness.

Various survey-based instruments were utilized, including MAESTRA5-6+, which was implemented by Chytrý et al. (2020) to evaluate metacognitive knowledge. Additionally, the MARSI survey was employed to gauge participants' metacognitive awareness and reading comprehension. Mohamed and Shaaban (2023) utilized the Metacognitive Awareness of Writing Questionnaire (MAWQ) to assess metacognitive awareness in relation to students' writing proficiency. Furthermore, several other included studies, such as those conducted by (Arianto & Hanif, 2024; López-Vargas et al., 2017; Marantika, 2021; Mustopa et al., 2024; Potgieter & van der Walt, 2022; Razzak & Hamzah, 2023), also incorporated survey-based tools to evaluate metacognition in various educational settings.

Class observation and teacher assessment prominently depicted in many studies, providing qualitative insight into how metacognitive practices manifest in the real-world learning environment. Teachers' assessments of students' capabilities to plan, monitor, and assess their own learning yielded significant, context-relevant information. These approaches were frequently enhanced by the use of digital tools, which deepened the comprehension of metacognitive processes and their influence on educational efficiency. For example, (Hays et al., 2024; Mustopa et al., 2024; Potgieter & van der Walt, 2022) illustrated how digital tools supplemented traditional evaluations, offering immediate insights into students' metacognitive development and involvement.

Discussion
The findings of these systematic reviews highlight the important role of metacognition in increasing learning results, improving educational efficiency, and addressing contextual moderators and mediators that influence its application. By integrating evidence from diverse studies, this review underlines the potential of metacognition to transform educational practices, while also reveals areas that require further discovery.

Descriptive theme 1 confirmed that metacognitive strategies-such as planning, monitoring, and evaluating, enhanced academic performance, promoting self-regulated learning, and

develops higher-order cognitive skills. This aligns with prior research conducted by (Schraw et al., 2006), which asserted that metacognitive regulation serves as a crucial determinant of academic achievement, facilitating learners' capacity to assess and modify their strategies proficiently. In the realm of STEM education, findings revealed that the implementation of metacognitive strategies significantly enhanced students' self-efficacy and problem-solving abilities. These findings are corroborated by previous investigations, such as those by (Güner & Erbay, 2021), which highlighted the importance of metacognition in navigating complex problem-solving contexts. Furthermore, it was found by An et al. (2024) that metacognitive awareness provides students with essential tools for self-regulated learning, which is consistent with (Zimmerman, 2002) self-regulation framework that asserts the necessity of goal-setting and self-monitoring for fostering academic engagement and achievement.

In the field of humanities, findings have demonstrated that the implementation of metacognitive reading strategies specifically planning, monitoring, and evaluating led to a notable enhancement in comprehension abilities. This findings align with prior studies by (Babayiğit & Shapiro, 2020), which emphasized the effectiveness of metacognitive strategies in fostering literacy development.

Findings from the second **descriptive theme 2** indicate that the implementation of metacognitive practices significantly enhances educational efficiency by decreasing the time required for instruction, promoting the efficient use of resources, and supporting independent learning. This observation is consistent with the assertions made by (Efklides, 2011), who argued that metacognitive awareness allows learners to effectively prioritize tasks and allocate cognitive resources judiciously. Furthermore, it was found that teacher-led metacognitive interventions, yield systemic advantages, including a decreased need for remedial instruction and enhanced classroom efficiency.. These findings are corroborated by (Theobald, 2021), significantly improve students' conceptual understanding and foster greater autonomy. In a similar vein, the findings Razzaq and Hamzah (2023) which revealed that the use of metacognitive evaluation strategies in English as a Second Language (ESL) writing not only enhanced learners' proficiency but also reduced their reliance on teacher feedback, aligning with earlier research conducted by Graham and Perin (2007).

At the institutional level, educational institutions that have adopted metacognitive frameworks have observed enhancements in retention rates and a decrease in dropout rates among students who are underperforming. This finding is consistent with the meta-analysis conducted by (De Boer et al., 2018) meta-analysis, which recognized metacognitive instruction as one of the most impactful strategies for enhancing student performance.

Descriptive theme 3 affirmed the significance of contextual factors, including age, gender, cultural norms, and motivation, in determining the efficacy of metacognitive strategies. For example, Arianto and Hanif, (2024) found out that younger learners necessitated explicit instruction to effectively implement metacognitive strategies, whereas older students thrived when allowed to apply these strategies independently. This findings is consistent with the cognitive development framework proposed by (Bormanaki & Khoshhal, 2017) which posits that younger individuals require structured support due to their developing abstract reasoning capabilities. Gender disparities were underscored by (Mohamed & Shaaban, 2023), who discovered that female students demonstrated greater metacognitive awareness

compared to their male counterparts. This finding corroborates earlier research by (Franklin et al., 2018), which indicated a female advantage in cognitive and self-regulatory skills.

The cultural context also emerged in the findings from the included studies as a significant mediator influencing metacognitive strategy effectiveness. These insights are in line with Hofstede's (1984) cultural dimensions theory, as discussed by Abdelrahim, (2022), which asserts that learning preferences differ markedly between collectivist and individualist societies. Furthermore, findings from the included studies revealed that motivation is a crucial element in mediating the success of metacognitive strategies, aligning with (Ryan & Deci, 2023) self-determination theory, which emphasizes the importance of intrinsic motivation in promoting deep learning.

Finally, **descriptive theme 4** identified and also confirmed a range of assessment methods, including self-report inventories, classroom observation, and digital platforms.. The Metacognitive Awareness Inventory (MAI), referenced in the works of (Abdelrahman, 2020) and (Ozturk & Senaydin, 2019), remains a widely validated tool for evaluation of metacognitive awareness, This ongoing validation is consistent with earlier studies conducted by Schraw and Dennison (1994), as noted by (Teng, 2020). Classroom observations, as highlighted by (Albazi & Shukri, 2016), provided qualitative insight into the application of metacognitive strategies, consistent with the findings of (Perry & Rahim, 2011)Perry and Rahim (2011), who emphasized the importance of observing students In authentic learning environment.

While self-report tools and observations were prominent, limited use of real-time methods such as the think aloud protocol represents an area for improvement. This protocol, has been examined in the wider literature by Ericsson and Simon (1993), as referenced in Jääskeläinen, (2010), capture cognitive during task execution and can enrich the future assessment by providing dynamic insights into metacognitive behavior Is.

Strengths, Limitations, and Future Directions
This review synthesized across multiple educational levels and disciplines, providing a comprehensive understanding of metacognition's impact. By employing thematic synthesis, it has constantly consistent patterns and contextual variations, ensuring that the application to diverse educational contexts. However, several intervals were noted. The predominance of research employing quantitative methodologies (73.3%) and the narrow emphasis on primary education (13.3%) constrain the applicability of the results. Furthermore, there exists a geographical disparity, characterized by a lack of representation from African regions (6.7%), highlights the need for a more global approach on metacognition. Future investigations ought to focus on less studied contexts, including primary education and regions in Africa, to foster a more balanced comprehension of the role of metacognition in educational settings. Additionally, the implementation of real-time assessment methods, such as the "Think Aloud Protocol," has the potential to deepen our insights into the dynamics of metacognitive strategies as they manifest during learning activities. It is also essential for researchers to assess the enduring impacts of metacognitive interventions, especially in relation to systemic issues like teacher workload and student retention.

Policy and Practical Implications of the Study

The findings of this systematic review provide valuable insight to educators, policy makers, curriculum developers, and students, which highlight the effectiveness of the metacognitive strategies in increasing learning outcomes and overall academic efficiency. Educators can integrate metacognitive techniques such as self-questioning, setting goals and reflective journaling to improve teaching effectiveness and promote self-regulated learning among students By developing skills in planning, monitoring and evaluating their learning, students can increase the problem-solving, critical thinking, and autonomy, making them better prepared for both academic and professional challenges. These findings also support courses developers and policy makers in including metacognitive training in educational programs which ensure more structured and evidence-based approaches to teaching and learning. In addition, metacognitive strategies can be tailored to meet the needs of diverse learning, making education more inclusive and adaptable for various cognitive abilities and cultural backgrounds.

Beyond academic settings, these strategies are essential for lifelong learning and readiness of the workforce, as industries increasingly require employees who can acquire and apply knowledge in the dynamic. Finally, this study strengthens educational research and innovation by synthesizing insight into various methodologies, providing a foundation for future studies to explore new instructional models, digital learning environments and AI-driven educational devices. By effectively implementing metacognitive strategies, the education system can promote high academic achievement, improve efficiency, and cultivate independent, lifelong learners.

Conclusion

This systematic review underscores the transformative potential of metacognition in education, highlighting its significant contribution to learning outcomes, educational efficiency, and the role of contextual factors in shaping its effectiveness. Metacognitive strategies, including planning, monitoring, and evaluation, have been demonstrated to improve academic performance, promote self-regulated learning, and enhance problem-solving abilities across various disciplines and educational levels. These results underscore the essential importance of metacognitive awareness as a fundamental competency for lifelong learning. Educational efficiency was also found to be greatly benefited from metacognition, with evidence suggesting that these strategies optimize teaching practices, reduce instructional time, and promote greater independence among learners.

At the institutional level, metacognitive interventions have been linked to improved retention rates and reduced dropout rates, demonstrating their systemic impact. However, this review also highlights the influence of contextual moderators and mediators, such as age, gender, cultural norms, and motivation, teacher support which must be carefully considered to maximize the effectiveness of metacognitive strategies. Despite these promising findings, this review identifies several gaps in the existing literature. The predominance of research employing quantitative methodologies, coupled with a narrow emphasis on primary education and regions that are often overlooked, such as Africa, indicates a pressing requirement for more inclusive and varied research initiatives. In addition, limited use of real-time assessment methods, such as think aloud protocols, indicate an opportunity for future research to adopt a more dynamic and innovative approaches to understand metacognition

Moving forward, future studies should prioritize exploring underrepresented educational levels and geographical regions, employing diverse methodological frameworks and integrate real -time assessment techniques. By addressing these gaps, researchers and practitioners can better exploit the potential of metacognitive strategies to create equitable, efficient and impactful educational systems globally.

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